

# **CORRECTIVE ACTION GUIDANCE**

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## **I. INTRODUCTION**

This document outlines the criteria for corrective action of petroleum releases from regulated underground storage tanks (UST) and is designed to meet the applicable requirements of the South Carolina Underground Storage Tank Control Regulations, R.61-92 Part 280, and the SUPERB Site Rehabilitation and Fund Access Regulations, R.61-98.

Confirmed releases of petroleum or petroleum products where concentrations of Chemicals of Concern (CoC) are documented to be in excess of risk-based screening levels (RBSLs) require corrective action. Procedures as outlined in the South Carolina Risk-Based Corrective Action for Petroleum Releases guidance document shall be used to determine the corrective action goal or Site-Specific Target Level (SSTL). The SSTL is the maximum concentration each CoC can exist above the RBSL to ensure current or potential receptors are not adversely affected.

## **II. CONTRACTOR AND PROFESSIONAL CERTIFICATIONS**

All site rehabilitation activities performed for regulated petroleum underground storage tanks must be completed by a South Carolina Certified Underground Storage Tank Site Rehabilitation Contractor as required by R.61-98. Further, all assessment reports, corrective action plans, monitoring reports, and corrective action system evaluation reports should be signed by a South Carolina Registered Professional Geologist (PG) or Engineer (PE) as required by the South Carolina State Boards of Registration.

## **III. CORRECTIVE ACTION METHODOLOGIES**

Based on the concentration of each CoC and its potential risk to receptors, two processes of corrective action are possible: A) active corrective action and B) intrinsic remediation or natural attenuation.

**A. Active Corrective Action** – This term is synonymous with active remediation and refers to physical actions taken to reduce the concentrations of CoC. Active Corrective Action is applicable where:

1. The concentration of any CoC exceeds the SSTL and must be reduced to prevent an impact to an actual or potential receptor;
2. Free phase product is present with a thickness greater than 0.01 feet or 1/8 inch; or
3. The plume continues to increase in size, CoC continue to migrate away from the source, or the concentration of any individual CoC is increasing.

**B. Intrinsic Remediation or Natural Attenuation** - These terms refer to the naturally occurring microbial and fate and transport processes that results in a reduction of the total mass of hydrocarbons. Intrinsic remediation is applicable where:

1. The concentration of any CoC exceeds the RBSL but is less than the SSTL;
2. Measurable free product is not present;
3. The CoC plume is at or approaching equilibrium (i.e., the advancement of the plume is slowing down), and the concentration of a CoC is not increasing at any point;
4. The predicted impact on actual or potential receptors does not exceed the RBSL at any time (i.e., no predicted risk to human health or the environment); and
5. All conditions for intrinsic remediation can be verified in 18 months or less.

An intrinsic approach may need to be upgraded to active corrective action if the above conditions cannot be demonstrated, a new or potential receptor is identified, or if there is a change in land use or zoning ordinances.

**III. FUNDING** - For releases funded by the State Underground Petroleum Environmental Response Bank (SUPERB) Account or Federal Leaking Underground Storage Tank Trust Fund, pre-approval of all costs is required. If the release is funded from SUPERB, the owner or operator of the underground storage tanks can select his own contractor, or upon request, the Department can procure a contractor on their behalf. The Department procures the contractor on all releases using Federal Trust funds.

**IV. ACTIVE CORRECTIVE ACTION PROCEDURES** – All corrective actions implemented through the Underground Storage Tank Program are completed using “Pay-for-Performance” procedures. Once the extent and severity of contamination is identified and a cleanup goal or SSTL is established, the SSTL mass of petroleum to be removed is established. A contractor then enters into a Pay-for-Performance contract by which they are paid a percentage of the contract amount as they document progress toward meeting the final cleanup goal or SSTL.

**A. Data collection** - Prior to implementation of Corrective Action, the horizontal and vertical extent of CoC in the soil and groundwater, aquifer characteristics, and SSTLs are determined. This data is typically collected during Tier 1, Tier 2, and Tier 3 assessments as described in the Department’s guidance documents.

**B. Financial approval** – Reasonable costs are determined through a competitive bidding procedure. The Department prepares a bid specification which includes a synopsis of the assessment data collected and outlines the cleanup goal (SSTLs) to be met. The bid specification is sent to the owner or operator, and is also published in “South Carolina Business Opportunities.” Each contractor that desires to participate should propose the technology, estimated time to completion, and total cost that they feel will achieve the necessary SSTL in a safe, timely, and cost efficient manner.

On the bid opening date, all sealed bids are opened in public. Any bids submitted by companies that are not certified, any technologies that cannot be permitted or are not safe, or include estimated cleanup time frames that are unreasonably long, or will not be protective of the receptors, will be rejected. The most competitive rate is accepted as the reasonable cost for corrective action of that site. Award will go to the company selected by the owner or operator. If the owner or operator chooses a contractor that was not the most competitive bidder, the Department is not responsible for paying any costs above the lowest bid.

**C. Corrective Action Plan and Permit Preparation** – The contractor that wins the award should submit a Corrective Action Plan and any necessary permit applications to the Department in accordance with the schedule outlined in the bid specification. The Corrective Action Plan should include, at a minimum:

1. A brief description of how the proposed technology (ies) will reduce the concentrations of CoC at each compliance well to the established Site-Specific Target Level (SSTL). Scientific models, computations, and/or data from other case studies should be included which establish a predicted radius of influence and justify the proposed locations of recovery or injection wells, trenches, and other features.
2. Proposed construction details for all temporary and permanent wells, trenches, or other features that will be needed to implement the corrective action. Their locations should be depicted on a site map in addition to other pre-existing features such as monitoring wells,

and aboveground structures. Please note that the locations of proposed construction should be discussed with the property owner with minimal disruption to any existing commercial or residential uses.

3. A copy of the relevant portion of the tax map shall be included with a list of the property owner's names, tax map numbers, and mailing addresses for each property that: a) is currently impacted by petroleum, b) may become impacted by petroleum, c) has monitoring wells on it, or d) adjoins a property that fits in categories a), b), or c).
4. A brief description of how any waste materials (wastewater, impacted soil, air) that may be generated will be handled.
5. A brief description of any potential exposure that the contractor or other citizens may face during the cleanup process and how these potential exposures will be managed to prevent any risk to human health.
6. A detailed monitoring proposal that complies with that required in the bid specification.
7. A detailed description of the methods that will be used for deactivating and removing any wells and equipment added as a part of site rehabilitation.
8. An implementation schedule should be provided that outlines when the contractor will: a) initiate and complete construction, b) submit the baseline monitoring report, c) initiate corrective action(s), d) submit quarterly corrective action system evaluation reports, e) reach SSTLs, f) complete the post-remediation verification monitoring, and g) remove all equipment and abandon all wells as required by the bid specification. It is recognized that items e), f), and g) are estimates.
9. Original Performance Bond or Irrevocable Standby Letter of Credit.
10. A completed Bureau of Air Quality Control Modeling Form should be submitted with the CAP if air emissions will be generated.
11. An Underground Injection Control Permit Application is required if injection of any solid, liquid, or gas (including ambient air) is proposed. If the injectate includes nutrients, microorganisms, or chemicals, a review of its safety by the state toxicologist is necessary unless previously determined. Please see Section D. for more information. If it has already been reviewed for another site, please provide a copy of the review memorandum.

**D. Bioremediation Safety Guidelines** – To evaluate the safety of a proposed injectate, the following information, at a minimum, is needed:

1. Manufacturers name, address, telephone number, and authorized representative for data disclosure.
2. SCDHEC project manager and telephone number.
3. Site contact person, address, and telephone number.
4. Contractor applying product, contact person, address, and telephone number.
5. A map depicting the site and the locations of all local private and public water supply wells.
6. Analytical results from a certified laboratory quantifying the CoC present in the soil.
7. Genus/species/strain of microorganism(s) contained in product (if requested, this will be maintained as confidential information).
8. Identity of specific nutrients and other additives contained in the product (if requested, this will be maintained as confidential information).
9. Documentation of evidence from authoritative technical references (e.g., Bergey's, etc.) that the microorganisms are not pathogenic to animals or humans.
10. Documentation that microorganisms are naturally occurring in the immediate or similar environment.
11. Documentation of specific degradation products expected.

12. Documentation of migratory potential of contaminants and degradation products in soil groundwater, and air.
13. Complete description of the bioremediation process on a site (e.g., application of the product to soil and/or groundwater, aeration of the soil, procedures needed to maintain microbial growth and chemical degradation).
14. Complete description of all potential exposure avenues to humans, animals, and the environment of contaminants and contaminated materials.
15. Disposal procedures for all contaminated materials which result from the bioremediation process.

**E. Public Notice** - Pursuant to the South Carolina Underground Storage Tank Control Regulations, R.61-92, Section 280.67, the Department provides notice to the public of pending corrective actions. The method of notification is tailored in each situation to reach those members of the public directly and indirectly affected by the planned corrective action. Notices may be posted at or in the vicinity of the site. Notices may also be provided to the owner or operator of the underground storage tanks that are suspected to be the source, and owners of local property that: a) is currently impacted by petroleum, b) may become impacted by petroleum, c) has monitoring wells on it, or d) adjoins to property that fits in categories a), b), or c). The duration of the public notice should be long enough to give the public a chance to provide their comments (usually 14 to 30 days).

If the comments and questions received cannot be adequately answered on an individual basis or if a large number of people have questions, a meeting may be scheduled in their local area at a time suitable to encourage participation. The UST owner or operator and/or the site rehabilitation contractor may be invited to the meeting to further discuss the rehabilitation actions proposed in the Corrective Action Plan.

**F. Notice to Proceed** – Once the public notice process and all permits have been issued, the Department will issue a notice to proceed with corrective action. This notice does not imply any endorsement that the proposed method will work or that it will achieve the standards (SSTLs) in the most efficient manner possible. The contractor is responsible for ensuring that the system achieves the required results and for any necessary additions or modifications to the system to achieve the required results. The Department should receive prior notification of any proposed changes (other than changing pumping, injection, or air pressure rates).

A comprehensive round of groundwater samples will be required prior to initiation of the treatment process outlined in the Corrective Action Plan. Analytical parameters will be specified in the bid specification.

**F. Corrective Action System Evaluations** – Quarterly corrective action system evaluations (CASE) and monitoring reports documenting progress must be submitted. The reporting schedule will be outlined in the bid specification. Each CASE should include the following, at a minimum:

1. Brief description of any construction or treatment system adjustments completed by the site rehabilitation contractor since the previous report. Well completion logs and treatment system construction schematics may be included in the appendix.
2. A table summarizing the measurement of any observed free product and groundwater potentiometric data. In addition, a brief description and a map depicting the most current groundwater flow direction and gradient and any observed historical trends, should be included.

3. A table summarizing the historical and current analytical results from all monitoring wells which are required to be sampled pursuant to the bid specification. Cleanup goals or SSTLs should also be noted. The total mass exceeding SSTL should be calculated in accordance with the formula and example included in Section H. Negative values should not be used.
4. A brief discussion should be included which describes the contractors' on-going efforts to maximize the time efficiency of the treatment process.
5. A revised implementation schedule should be included which more accurately estimates when the cleanup process will be complete.
6. Site maps, analytical results, well purging records, and any applicable soil or water disposal manifests should be included in the appendix.

**G. Calculation of % mass removed and Pay-for-Performance Payments** – The following formula will be used to calculate the percent total mass reduction: total mass above the cleanup goal or SSTLs from initial sampling less total mass above cleanup goal or SSTLs from subsequent sampling divided by total mass above cleanup goal or SSTLs from initial sampling.

The following is an example to demonstrate the CoC Mass Reduction Calculation:

Well		Benzene	Toluene	Ethylbenzene	Xylene	MTBE	Naphthalene	Mass>SSTL
MW-1	Initial <sup>A</sup>	7,500	4,000	2,000	15,000	3,000	1,000	<sup>A</sup>
	SSTL <sup>B</sup>	10	2,000	1,400	10,000	80	50	<sup>B</sup>
	Initial > SSTL <sup>C</sup>	7,490	2,000	600	5,000	2,920	950	18,960 <sup>C</sup>
	Subsequent <sup>D</sup>	3,000	1,000	900	13,000	2,000	5	<sup>D</sup>
	SSTL <sup>E</sup>	10	2,000	1,400	10,000	80	50	<sup>E</sup>
	Subsequent > SSTL <sup>F</sup>	2,990	0	0	3,000	1,920	0	7,910 <sup>F</sup>
MW-4	Initial <sup>G</sup>	150	400	50	250	300	25	<sup>G</sup>
	SSTL <sup>H</sup>	5	400	50	250	40	25	<sup>H</sup>
	Initial > SSTL <sup>I</sup>	145	0	0	0	260	0	405 <sup>I</sup>
	Subsequent <sup>J</sup>	100	100	1	1	100	1	<sup>J</sup>
	SSTL <sup>K</sup>	5	400	50	250	40	25	<sup>K</sup>
	Subsequent > SSTL <sup>L</sup>	95	0	0	0	60	0	155 <sup>L</sup>
Totals	Initial > SSTL <sup>M</sup>	(sum of initial mass above SSTL for all wells) (C+I)						19,365 <sup>M</sup>
	Subsequent > SSTL <sup>N</sup>	(sum of subsequent mass above SSTL for all wells) (F+L)						8,065 <sup>N</sup>

Notes: \* If subsequent sampling indicates a CoC concentration value at or below the cleanup goal or SSTL and/or a CoC concentration below laboratory detection level but reporting level less than cleanup goal or SSTL for any constituent, the value for the mass reduction will be 0 (no negative numbers).

\* If subsequent sampling indicates a CoC concentration below the laboratory detection level but the reporting limit is greater than cleanup goal or SSTL, the value for any constituent will be the analytical reporting limit.

## Mass Reduction Calculation

$$\begin{array}{lcl} \text{CoC Mass Reduction} & = & \frac{(M-N)}{(M)} = \frac{(19,365-8,065)}{19,365} = 0.5835 * 100 = 58.35\% \\ \text{CoC Reduction} & & \end{array}$$

Compensation to the owner or operator or the site rehabilitation contractor is calculated as a percentage of the total bid price as interim performance milestones are achieved and paid in accordance with the specifications in the corrective action contract. A typical payment schedule is:

Initial payment when system is fully operational	40% payment
When total mass above SSTL is reduced by 25%	10% payment
When total mass above SSTL is reduced by 50%	10% payment
When total mass above SSTL is reduced by 75%	15% payment
When SSTL is achieved and equipment removed	<u>25%</u> payment
	100%

**H. Completion of Active Corrective Action** – Once analytical results indicate that the concentration of each CoC at each monitoring point is below the cleanup goal or SSTL and the conditions in the bid specification have been met, the contractor may request authorization from the Department to stop the treatment system. Once granted, the contractor will begin the post-remediation monitoring and verification cycle. The Department may require the installation of verification borings and wells. The number of verification points, analytical parameters, and the duration of the post-remediation verification process are specified in the bid specification.

Once the verification process, as outlined in the bid specification, is complete and all concentrations of CoC are confirmed to remain less than the cleanup goal or SSTL, the Department will issue approval for the contractor to remove their corrective action equipment, abandon pipe runs, and abandon monitoring wells.

## VI. INTRINSIC CORRECTIVE ACTION PROCEDURES

- A. Data collection** - Prior to implementation of Corrective Action, the horizontal and vertical extent of CoC in the soil and groundwater, aquifer characteristics, and SSTLs are determined. This data is typically collected during Tier 1, Tier 2, and Tier 3 assessments as described in the Department's guidance documents.
- B. Financial approval** – SUPERB Allowable costs for the intrinsic remediation-monitoring program are pre-established based on individual rates for the tasks to be completed.
- C. Basics of Intrinsic Remediation** – Intrinsic remediation refers to the naturally occurring microbial and fate and transport processes that results in a reduction of the total mass of hydrocarbons. A monitoring program is implemented to gather the necessary data to support that intrinsic remediation is reducing the concentrations of CoC. Once the evidence documents that site conditions are suitable and that intrinsic remediation is taking place, an intrinsic corrective action report (ICAR) is then prepared to justify the issuance of a Conditional No Further Action and the discontinuation of monitoring.

- D. Monitoring** - The primary evidence for intrinsic remediation shall be the observed reduction in the concentration of each CoC in each well and a corresponding reduction in the overall size and geometry of the plume.

Secondary evidence for intrinsic remediation includes further computer modeling of solute and transport rates or estimates of assimilative capacity, and the collection of geochemical parameters that support the depletion of nutrients or the generation of by-products as a result of biological or chemical processes. The most common geochemical parameters include: dissolved oxygen, temperature, nitrate, sulfate, ferrous iron, and methane. Other less common geochemical parameters that may also help include: total organic carbon, redox potential, soluble salts, buffer index, soluble potassium, sodium, calcium, sulfur, boron, copper, zinc, cation exchange capacity, exchangeable ions, soluble phosphorous, and soluble manganese.

A monitoring well located hydraulically down gradient of the source is always needed to verify that the plume is not continuing to migrate. Initially all monitoring wells should be sampled for all CoC which have concentrations exceeding the RBSL, and for secondary geochemical parameters. Accepted analytical methodologies are outlined in the Department's "Analytical Methodology" guidelines. The data from the first sampling event should be evaluated for evidence of CoC reductions, plume migration, and biological or geochemical evidence of intrinsic remediation such as oxidation, de-nitrification, or methanogenesis. Sampling parameters for future events should be tailored to address those biological and geochemicals parameters that provide the strongest evidence of intrinsic remediation.

Typically, quarterly sampling during the first year is needed to establish seasonal variabilities. The frequency after the fourth quarter should be established based on a review of all historical water table fluctuations and CoC variations.

- E. Intrinsic Monitoring Report** - Each intrinsic monitoring report should include the following:

1. A data table summarizing the measurement of any groundwater potentiometric data. In addition, a brief description and a site map depicting the most current groundwater flow direction and gradient and any observed historical trends should be included.
2. A data table summarizing the historical and current analytical results of CoC and geochemical parameters from all monitoring wells, which were sampled.
3. A brief description of any observed historical CoC concentration trends and any geochemical evidence supporting intrinsic remediation.
4. Topographic and site maps depicting the locations of former or existing underground storage tanks lines and dispensers, monitoring wells, buildings, and other structures.
5. Analytical results, well purging records, and any applicable soil or water disposal manifests should be included in the appendix.

- F. Intrinsic Corrective Action Plan** - Once the monitoring program has gathered the needed evidence that supports that site conditions are suitable and that intrinsic remediation is taking place, an intrinsic corrective action plan (ICAP) is prepared to justify the issuance of a "Conditional No Further Action" decision, and the discontinuation of monitoring. The ICAP contains the elements for the Intrinsic Monitoring Report and the following:

1. A copy of the relevant portion of the tax map shall be included with a list of the property owner's names, tax map numbers, and mailing addresses for each property that: a) is



currently impacted by petroleum, b) may become impacted by petroleum, c) has monitoring wells on it, or d) adjoins to property that fits in categories a), b), or c).

2. All available data should be used to estimate how long intrinsic remediation will take to restore the soil and groundwater to risk-based screening levels. These estimates may be derived by extrapolation of documented decreasing trends, or through calibration of scientific models using historical CoC and geochemical data. All input parameters and assumptions should be clearly identified.
3. The receptor survey should be verified and the local city or county authorities should be contacted for an update on the current applicable zoning and land use ordinances. A brief discussion of the findings should be included.
4. If the data supports that no unacceptable risk will result by leaving the CoC in place to naturally degrade during the estimated clean-up time frame, the report should recommend the termination of monitoring.

## **VI. NO FURTHER ACTION DECISION**

A “No Further Action” decision may be issued by the Department if the concentration of each CoC is at or below the RBSL. The samples that support the decision should be:

- A. Collected from the location(s) deemed most likely to represent the worst case CoC;
- B. Analyzed for appropriate parameters by a laboratory certified in the state of South Carolina for those parameters; and
- C. Collected in accordance with industry standards for quality assurance and quality control.

If a corrective action system was used, the “No Further Action” decision will only be issued after completion of a post-remediation monitoring program, which confirms that concentrations of each CoC remain below RBSL.

## **VII. CONDITIONAL NO FURTHER ACTION DECISION**

Pursuant to The SUPERB Site Rehabilitation and Fund Access Regulations, R.61-98, a “Conditional No Further Action” decision can be granted once the following has been demonstrated:

- A. the SSTL have been met;
- B. the CoC have reached equilibrium or are not moving at a significant rate;
- C. concentrations of CoC are not increasing;
- D. no unacceptable risk to human health, safety, or the environment exists; and
- E. concentrations of CoC will not exceed RBSL at the exposure point or receptor.

Prior to issuance of a “Conditional No Further Action” letter, the Department provides notice to the public to solicit comments and concerns. The method of notification is tailored in each situation to reach those members of the public directly and indirectly affected by the proposed decision.

A “Conditional No Further Action” letter is based on site-specific conditions and the current and reasonably anticipated future use of the site. The letter will outline all land use assumptions and conditions at the time the decision is made. The Department will be notified by the underground storage tank owner or operator within 30 days of any changes in the listed assumptions or conditions so that the potential risk can be re-evaluated. Examples of assumptions or conditions that may be attached to a “Conditional No Further Action” letter include, but are not limited to:

- A. The property is zoned for commercial use and should remain commercial in the future.
- B. Water wells are not currently installed in the impacted area and should not be installed in that area in the future.
- C. Local ordinance precludes the installation of potable wells.

The Department maintains a Registry of Releases for all “Conditional No Further Action” decisions. The longitude and latitude from the Geodetic Information System , local tax map number, and street address of each closed conditional release is available at the Department’s Freedom of Information office (803) 898-3882. If a person is later able to demonstrate all CoC are below the RBSL, then that person may request that the release be removed from the registry of releases and a “No Further Action” decision be issued by the Department.

## **VIII. WELL ABANDONMENT**

Once the UST owner or operator is notified of a “No Further Action” or a “Conditional No Further Action” decision, abandonment of the monitoring wells is suggested to minimize the possibility of leakage of future spills into the groundwater aquifer. Abandonment shall be by a South Carolina certified well driller in accordance with the South Carolina Well Standards and Regulations, R.61-71. The UST owner or operator may also choose to keep these wells for future monitoring purposes. If this option is chosen, the UST owner or operator becomes responsible for the future maintenance and abandonment of the monitoring wells.